What is claimed is:

1. A generator system having at least first and second modes, the generator system producing a first alternating current output voltage when in the first mode and producing the first alternating current output voltage and a second alternating current output voltage when in the second mode, the second output voltage being twice the first output voltage, comprising:

first and second voltage sources each having an output at which they produce the first output voltage;

a switch coupling the first and second outputs of the first and second voltage sources in parallel when the switch is in a first position and in series when the switch is in a second position, the first output voltage produced at the outputs of the first and second voltage sources when the switch is in the first position and the second output voltage produced across the series coupled outputs of the first and second voltage sources when the switch is in the second position with the first output voltage also produced at the outputs of the first and second voltage sources when the switch is in the second position.

2. The generator system of claim 1 wherein the current available at the first output voltage when the outputs of first and second voltage source are coupled in parallel is greater than the current available at the first output voltage when the outputs of the first and second voltage sources are coupled in series.

3. The generator system of claim 1 and further including a controller coupled to the first and second voltage sources, the controller operating the first and second voltage sources so that their first output voltages are in phase when the switch is in the first position and one-hundred and eighty degrees out of phase when the switch is in the second position.

4. The generator system of claim 3 wherein the controller includes a first controller for controlling the first voltage source and a second controller for controlling the second voltage source.

5. The generator system of claim 1 wherein the first and second voltage sources each include a generator coupled to an AC power converter having an output that provides the output of that first and second voltage source.

6. The generator system of claim 5 wherein a single generator having first and second sets of windings provides the generators of the first and second voltage sources, the first set of windings coupled to the AC power converter of the first voltage source to provide the generator of the first voltage source and the second set of windings coupled to the AC power converter of the second voltage source to provide the generator of the second voltage source.

7. The generator system of claim 6 wherein the AC power converters of the first and second voltage sources include cycloconverters.

8. The generator system of claim 7 and further including a controller coupled to the cycloconverters of the first and second voltage sources, the controller operating the cycloconverters of the first and second voltage sources so that they are in phase when the switch is in the first position and one-hundred and eighty degrees out of phase when the switch is in the second position.

9. The generator system of claim 8 wherein the controller operates the cycloconverters using cosine control.

10. The generator system of claim 9 wherein the generator includes at least one rotor position sensor that senses the position of a rotor of the generator and generates a signal indicative of the position of the rotor.

11. The generator system of claim 10 wherein the controller uses the rotor position signal to develop control waves which it uses to control the cycloconverters.

12. The generator system of claim 9 wherein the generator includes rotor position sensors that generate signals indicative of the position of the rotor that are displaced one-hundred and twenty degrees from each other.

13. The generator system of claim 12 wherein the controller uses the rotor position signals to develop control waves which it uses to control the cycloconverters.

14. The generator system of claim 13 wherein each cycloconverter includes a positive and a negative bank of naturally commutated switching devices.

15. The generator system of claim 14 wherein the controller generates a reference wave and controls the cycloconverters by generating firing signals for the naturally commutated switching devices based on comparisons of the control waves to the reference wave.

16. The generator system of claim 15 wherein the naturally commutated switching devices include silicon controlled rectifiers.

17. The generator system of claim 15 wherein each naturally commutated switching devices includes a silicon controlled rectifier/opto-silicon controlled rectifier combination.

18. The generator system of claim 15 wherein the first and second generators are three-phase generators with each of the first and second sets of windings having at least one winding for each phase.

19. The generator system of claim 10 wherein the generator includes an engine and a brushless DC motor drive circuit coupled to at least one set of the generator windings for driving the generator as a brushless DC motor to start the engine, the rotor position sensor coupled to a brushless DC motor controller of the brushless DC motor drive circuit.

20. The generator system of claim 12 wherein the generator includes an engine and a brushless DC motor drive circuit coupled to at least one set of the generator windings for driving the generator as a brushless DC motor to start the engine, the rotor position sensors coupled to a brushless DC motor controller of the brushless DC motor drive circuit..

21. The generator system of claim 10 wherein the rotor position sensor includes a hall effect transducer.

22. The generator system of claim 12 wherein the rotor position sensors include hall effect transducers.

23. The generator system of claim 20 wherein the rotor position sensors include hall effect transducers.

24. The generator system of claim 1 wherein the switch includes a single pole switch.

25. The generator system of claim 24 wherein the outputs of the first and second voltage sources each have live and neutral outputs, the single pole switch being one single pole relay with the single pole of the single pole relay coupled across the live output of the first voltage source and the live output of the second voltage source.

26. The generator system of claim 14 wherein the controller operates the positive and negative banks of naturally commutated switching devices of each cycloconverter in a non-circulating mode, the controller enabling one of the positive and negative banks and disabling the other of the positive and negative banks of each cycloconverter based on the instantaneous output current of that cycloconverter.

27. The generator system of claim 26 wherein the controller disables the positive bank of each of the cycloconverters when the instantaneous output current of that cycloconverter transitions from positive to negative, and then enables the negative bank of that cycloconverter only after a true zero current condition at the output of that cycloconverter occurs, the controller further disabling the negative bank of each of the cycloconverters when the instantaneous output current of that cycloconverter transitions from negative to positive and then enables the negative bank of that cycloconverter only after a true zero current condition at the output of that cycloconverter occurs.

28. The generator system of claim 27 wherein for each cycloconverter the true zero current condition at the output of that cycloconverter is determined by a comparator determining that actual output current of that cycloconverter is between first and second reference levels.

29. The generator system of claim 28 wherein the first and second reference levels are +25 mA and -25 mA.

30. The generator system of claim 27 wherein for each cycloconverter the controller determines that the true zero current condition at the output of that cycloconverter occurs by sensing that the positive and negative banks of that cycloconverter are non-conducting.

31. The generator system of claim 30 wherein the controller sensing that the positive and negative banks of one of the cycloconverters are non-conducting includes sensing that the voltage across each of the naturally commutated switching devices of the positive and negative banks of that cycloconverter is above a predetermined level.

32. The generator system of claim 27 and further including a bandpass filter for each cycloconverter for filtering the instantaneous output current of that cycloconverter to reduce current ripple and ensure that a signal output by the bandpass filter at a fundamental frequency does not have any phase-shift relative to the instantaneous output current of that cycloconverter, the signal output by the bandpass filter coupled to an input of a comparator that generates a signal indicative of whether the instantaneous output current transitioned from positive to negative or from negative to positive.

33. The generator system of claim 32 wherein the fundamental frequency is 60Hz.

34. The generator system of claim 1 wherein the first output voltage is nominally 120 VAC and the second output voltage is nominally 240 VAC.

35. A generator system, comprising:

an AC generator having an output coupled to a cycloconverter, the cycloconverter having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices;

a controller coupled to the naturally commutated switching devices of the positive and negative banks;

a rotor position sensor for sensing the position of a rotor of the generator and generating a signal indicative of the position of the rotor, the rotor position sensor coupled to the controller;

the controller using the rotor position signal to develop control waves which it uses to control switching of the naturally commutated switching devices of the positive and negative banks.

36. The generator system of claim 35 wherein the rotor position sensor includes a plurality of rotor position sensors that generate signals indicative of the position of the rotor that are displaced one-hundred and twenty degrees from each other.

37. The generator system of claim 36 wherein the plurality of rotor position sensors include hall effect transducers.

38. The generator system of claim 36 wherein the controller generates a reference wave and generates firing signals for the naturally commutated switching devices of the positive and negative banks based on comparisons of the control waves to the reference wave.

39. The generator system of claim 38 wherein the AC generator includes an engine and a brushless DC motor drive circuit coupled to the AC generator for driving the AC generator as a brushless DC motor to start the engine, the rotor position sensors coupled to a brushless DC motor controller of the brushless DC motor drive circuit.

40. The generator system of claim 36 wherein for each cycloconverter the controller operates the positive and negative banks of that cycloconverter in a non-circulating mode, the controller enabling one of the positive and negative banks and disabling the other of the positive and negative banks based on the instantaneous output current of that cycloconverter.

41. The generator system of claim 40 wherein, for each cycloconverter, the controller enables one of the positive and negative banks of that cycloconverter and disables the other of the positive and negative banks of that cycloconverter based on the instantaneous output current of that cycloconverter transitioning between positive and negative or between negative and positive wherein the controller enables one of the positive and negative banks of that cycloconverter only after a true current zero condition occurs at the output of that cycloconverter.

42. The generator system of claim 41 wherein for each cycloconverter the true zero current condition at the output of that cycloconverter is determined by a comparator determining that actual current output current of that cycloconverter falls between first and second reference levels.

43. The generator system of claim 42 wherein the first and second reference levels are +25 mA and -25 mA.

44. The generator system of claim 41 wherein the controller determines that the true zero current condition at the output of one of the cycloconverters occurs by sensing that the positive and negative banks are non-conducting.

45. The generator system of claim 44 wherein the controller sensing that the positive and negative banks are non-conducting includes sensing that that voltage across each of the naturally commutated switching devices and sensing that the positive and negative banks is above a predetermined level.

46. The generator system of claim 41 and further including a bandpass filter for filtering the instantaneous output current of the cycloconverter to reduce current ripple and ensure that a signal output by the bandpass filter at a fundamental frequency does not have any phase-shift relative to the instantaneous output current, the signal output by the bandpass filter coupled to an input of a comparator that generates a signal indicative of whether the instantaneous current output has transitioned from positive to negative or from negative to positive.

47. The generator system of claim 46 wherein the fundamental frequency is 60Hz.

48. The generator system of claim 35 wherein the naturally commutated switching devices include silicon controlled rectifiers.

49. The generator system of claim 35 wherein each naturally commutated switching device includes a silicon controlled rectifier/opto-silicon controlled rectifier combination.

50. A generator system, comprising:

an AC generator having an output coupled to a cycloconverter, the cycloconverter having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices;

a controller coupled to the naturally commutated switching devices of the positive and negative banks;

the controller operating the positive and negative banks in a non-circulating mode, the controller enabling one of the positive and negative banks and disabling the other of the positive and negative banks based on the instantaneous output current of the cycloconverter;

a bandpass filter for filtering the instantaneous output current of the cycloconverter to reduce current ripple and ensure that a signal output by the bandpass filter at a fundamental frequency does not have any phase shift relative to the instantaneous output current, the signal output by the band pass filter coupled to an input of a comparator that generates a signal indicative of whether the instantaneous output current has transitioned from positive to negative or from negative to positive.

51. The generator system of claim 50 wherein the controller enables one of the positive and negative banks only after it disables the other of the positive and negative banks and it senses that an output of the cycloconverter has passed through a true zero current condition, the controller sensing that the true zero current condition at the output of the cycloconverter occurs when a voltage across each of the naturally commutated switching devices is above a predetermined level indicating that each of the naturally commutated switching devices is non-conducting.

52. The generator system of claim 50 wherein the fundamental frequency is 60 Hz.

53. The generator system of claim 50 wherein each naturally commutated switching device includes a silicon controlled rectifier/opto-silicon controlled rectifier combination.

54. A generator system, comprising:

an AC generator having an output coupled to a cycloconverter, the cycloconverter having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices;

each naturally commutated switching device including a silicon controlled rectifier/opto-silicon controlled rectifier combination.

55. A dual mode generator system having a nominal output voltage of 120 VAC when it is in a first mode and nominal output voltages of both 120 VAC and 240 VAC when it is in a second mode, comprising:

a permanent magnet generator having first and second sets of isolated three-phase windings and a rotor;

an engine for driving the rotor of the permanent magnet generator;

a plurality of rotor position sensors that generate signals indicative of the position of the rotor that are displaced one-hundred and twenty degrees from each other;

a first cycloconverter coupled to the first set of windings of the generator and a second cycloconverter coupled to the second set of windings of the generator;

the first and second cycloconverters each having a live output and a neutral output, the live output of the first cycloconverter coupled to a live output of a first outlet and the neutral output of the first cycloconverter coupled to a neutral output of the first outlet, the live output of the second cycloconverter coupled to a live output of a second outlet and the neutral output of the second cycloconverter coupled to a neutral output of the second outlet;

the first and second cycloconverters each having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices;

a first filter capacitor coupled across the live output and neutral output of the first cycloconverter and a second filter capacitor coupled across the live output and neutral output of the second cycloconverter;

a third outlet coupled across the live outputs of the first and second outlets and a switch coupled across the live outputs of the first and second outlets;

a controller coupled to the naturally commutated switching devices and to the rotor position sensors;

the controller using the signals generated by the rotor position sensors to develop cosine control waves which it uses to control the switching of the naturally commutated switching devices of the first and second cycloconverters;

the controller operating the first and second cycloconverters so that output voltages at the live outputs of the first and second cycloconverters are in phase when the generator system is in a first mode with the switch closed paralleling the live outputs of the first and second cycloconverters where the nominal 120 VAC output voltage is produced at the first and second outlets with a greater available current than when the generator system is in the second mode;

the controller operating the first and second cycloconverters so that the output voltages at the live outputs of the first and second cycloconverters are one-hundred and eighty degrees out of phase with each other when the generator system is in a second mode with the switch open coupling the third outlet in series with the live outputs of the first and second cycloconverters with the nominal 120 VAC output voltage produced at the first and second outlets and the nominal 240 VAC output voltage produced at the third outlet.

56. The generator system of claim 55 wherein and further including an engine to drive the generator and a brushless DC motor drive circuit coupled to the generator and the rotor position sensors, the brushless DC motor drive circuit driving the generator as a brushless DC motor to start the engine.

57. The generator system of claim 56 wherein the rotor position sensors include hall effect transducers.

58. The generator system of claim 55 wherein the switch is a single pole switch.

59. The generator system of claim 58 wherein the single pole switch is a single pole relay.

60. The generator system of claim 55 wherein each naturally commutated switching device includes a silicon controlled rectifier/opto-silicon controlled rectifier combination.

61. The generator system of claim 55 wherein the controller operates the positive and negative banks of naturally commutated switching devices of each cycloconverter in a non-circulating mode, the controller enabling one of the positive and negative banks of each cycloconverter and disabling the other of the positive and negative banks of each cycloconverter based on the instantaneous output current of that cycloconverter transitioning between positive and negative or between negative and positive wherein the controller enables one of the positive and negative banks of each cycloconverter only after it senses that a true current zero condition occurs at the live output of that cycloconverter.

62. The generator system of claim 61 wherein the controller senses that a true current zero condition occurred at a live output of one of the cycloconverters when it senses that a voltage across each of the naturally commutated switching devices of the positive and negative banks of that cycloconverter is above a predetermined level indicating that each of the naturally commutated switching devices of that cycloconverter is non-conducting.

63. The generator system of claim 62 and further including a bandpass filter for each cycloconverter for filtering the instantaneous output current at the live output of the cycloconverter to reduce current ripple and ensure that a fundamental 60 Hz component of a signal output by each bandpass filter does not have any phase-shift relative to the instantaneous output current at the live output of the cycloconverter, the signal output by the bandpass filter input to a comparator that generates a signal indicative of whether the instantaneous output current transitions between positive and negative or between negative and positive.

64. The generator system of claim 55 wherein when the generator system switches between modes, the controller, if the generator system is switching from the first mode to the second mode:

a. opens the switch;
b. then disables the naturally commutated switching devices of the first and second cycloconverters so that they are all non-conducting; and
c. after a predetermined delay, reenables the naturally commutated switching devices of the first and second cycloconverters so that the live outputs of the first and second cycloconverters are one-hundred and eighty degrees out of phase with each other;

and the controller if the generator system is switching from the second mode to the first mode:

a. disables the naturally commutated switching devices of one of the first and second cycloconverters;
b. reenables after a predetermined delay the naturally commutated switching devices that were disabled so that the live outputs of the first and second cycloconverters are in-phase; and then
c. closes the switch.

65. The generator system of claim 64 wherein the predetermined delay is 3.5 electrical cycles.

66. A method of controlling a generator system having at least first and second modes where the generator system produces a first alternating current output voltage when it is in the first mode and produces the first output voltage and a second alternating current output voltage when it is in the second mode, the second output voltage twice the first output voltage, comprising:

coupling the outputs of the first and second voltage sources in parallel and operating the first and second voltage sources so that the voltages at the outputs of the first and second voltage sources are in phase when the generator system is in the first mode; and

coupling the outputs of the first and second voltage sources in series and operating the first and second voltage sources so that the voltages at the outputs of the first and second voltage sources are one-hundred and eighty degrees out of phase when the generator system is in the second mode with the second output voltage produced across the series coupled outputs of the first and second voltage sources and the first output voltage produced at each of the outputs of the first and second voltage sources.

67. The method of claim 66 including generating rotor position signals indicative of a position of a rotor of a permanent magnet generator and developing control waves from the rotor position signals, and using the control waves to control first and second cycloconverters, the first cycloconverter coupled to a first set of windings of the permanent magnet generator and the second cycloconverter coupled to a second set of windings of the permanent magnet generator, the first cycloconverter having an output that provides the output of the first voltage source and the second cycloconverter having an output that provides the output of the second voltage source.

68. The method of claim 67 including generating a reference wave, comparing the control waves to the reference wave, and controlling switching of naturally commutated switching devices of the first and second cycloconverters based on the comparisons of the control waves to the reference wave.

69. The method of claim 67 wherein the generator system includes an engine for driving the permanent magnet generator, the method including driving at least one of the first and second sets of windings of the permanent magnet generator with a brushless DC motor drive circuit to drive the permanent magnet generator as a brushless DC motor to start the engine, a brushless DC motor controller of the brushless DC motor drive circuit using the rotor position signals in driving the permanent magnet generator as a brushless DC motor.

70. The method of claim 67 wherein each cycloconverter includes a positive and a negative bank of naturally commutated switching devices, the method including operating the positive and negative banks of each cycloconverter in a non-circulating mode and enabling one of the positive and negative banks and disabling the other of the positive and negative banks of each cycloconverter based on the instantaneous output current of that cycloconverter transitioning between positive and negative or between negative and positive wherein the one of the positive and negative banks of one of the cycloconverter that is being enabled is enabled only after a true current zero condition occurs at the output of that cycloconverter.

71. The method of claim 70 including determining that the true current zero condition occurs at the output of one of the cycloconverters when all of the naturally commutated switching devices of that cycloconverter are non-conducting.

72. The method of claim 71 including sensing the voltages across the naturally commutated switching devices of each cycloconverter and determining that all the naturally commutated switching devices of one of the cycloconverters are non-conducting when the voltages across all of the naturally commutated switching devices of that cycloconverter are above a predetermined level.

73. The method of claim 72 including bandpass filtering the instantaneous output current of each of the cycloconverters to produce a filtered signal from that instantaneous output current to reduce current ripple and ensure that a fundamental frequency component of each filtered signal does not have any phase-shift relative to the instantaneous output current of the cycloconverter being filtered, and comparing each of filtered signals to at least one reference level to determine whether the instantaneous output current of the corresponding cycloconverter transitioned from positive to negative or from negative to positive.

74. The method of claim 73 wherein the reference level includes first and second reference levels of +0.1A and -0.1A and the fundamental frequency is 60 Hz.

75. The method of claim 66 wherein coupling the outputs of the first and second voltage sources in one of parallel and series includes switching a single pole switch coupled across the outputs of the first and second voltage sources open to couple the outputs in series and closed to couple the outputs in parallel.

76. The method of claim 75 wherein the single pole switch is a single pole relay.

77. The method of claim 70 wherein a switch is coupled between the outputs of the first and second voltage sources, the method including:

switching the generator system from the first mode to the second mode by first opening the switch, then disabling the naturally commutated switching devices of the first and second cycloconverters so that they are all non-conducting, and after a predetermined delay, reenabling the naturally commutated switching devices of the first and second cycloconverters and operating the first and second cycloconverters so that the voltages produced at the outputs of the first and second cycloconverters are one-hundred and eighty degrees out of phase with each other, and

switching the generator system from the second mode to the first mode by disabling the naturally commutated switching devices of one of the first and second cycloconverters, reenabling after a predetermined delay the naturally commutated switching devices that were disabled and operating the first and second cycloconverters so that the voltages produced at the outputs of the first and second cycloconverters are in-phase, and then closing the switch.

78. The method of claim 68 wherein generating the rotor position signal indicative of the position of the rotor of the permanent magnet generator includes generating rotor position signals that are displaced one-hundred and twenty degrees from each other.

79. The method of claim 78 wherein generating the rotor position signals includes generating them with hall effect transducers.

80. In a dual mode generator system having a nominal output voltage of 120 VAC when it is in a first mode and nominal output voltages of both 120 VAC and 240 VAC when it is in a second mode, the generator system having a permanent magnet generator having first and second sets of isolated three-phase windings and a rotor, an engine for driving the rotor of the permanent magnet generator, a plurality of rotor position sensors that generate signals indicative of the position of the rotor that are displaced one-hundred and twenty degrees from each other, a first cycloconverter coupled to the first set of windings and a second cycloconverter coupled to the second set of windings, each cycloconverter having a live output and a neutral output, the live output of the first cycloconverter coupled to a live output of a first outlet and the neutral output of the first cycloconverter coupled to a neutral output of the first outlet, the live output of the second cycloconverter coupled to a live output of a second outlet and the neutral output of the second cycloconverter coupled to a neutral output of the second outlet, the first and second cycloconverters each having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices, a first filter capacitor coupled across the live output and neutral output of the first cycloconverter and a second filter capacitor coupled across the live output and neutral output of the second cycloconverter, a third outlet coupled across the live outputs of the first and second outlets and a switch coupled across the live outputs of the first and second outlets in parallel with the third outlet, a method of operating the dual mode generator system, comprising

using the signals indicative of the position of the rotor of the permanent magnet generate to develop cosine control waves to control the switching of the naturally commutated switching devices of the first and second cycloconverters,

operating the generator system in the first mode with the switch closed coupling the live outputs of the first and second cycloconverters in parallel and operating the first and second cycloconverters so that output voltages at their live outputs are in phase where the nominal 120 VAC output voltage is produced at the first and second outlets with a greater available current than available when the generator system is in the second mode; and

operating the generator system in the second mode with the switch open coupling the live outputs of the first and second cycloconverters in series and operating the first and second cycloconverters so that the output voltages at their live outputs are one-hundred and eighty degrees out of phase where the nominal 120 VAC output voltage is produced at the first and second outlets and the 240 VAC output voltage is produced at the third outlet.

81. The method of claim 80 wherein the generator system includes an engine for driving the rotor of the permanent magnet generator, the method including using the rotor position signals to drive the permanent magnet generator as a brushless DC motor to start the engine.

82. The method of claim 80 including generating a reference wave, comparing the cosine control waves to the reference wave, and controlling switching of the naturally commutated switching devices of the first and second cycloconverters based on the comparisons of the cosine control waves to the reference wave.

83. The method of claim 81 including operating the naturally commutated switching devices of the positive and negative banks of each cycloconverter in a non-circulating mode and, for each cycloconverter, enabling one of the positive and negative banks of that cycloconverter and disabling the other of the positive and negative banks of that cycloconverters based on the instantaneous output current of that cycloconverter transitioning between positive and negative or between negative and positive and enabling that one of the positive and negative banks that is being enabled only after a true current zero condition occurs at the live output of that cycloconverter.

84. The method of claim 83 including determining for each cycloconverter that the true current zero condition occurred at the live output of that cycloconverter when all the naturally commutated switching devices of that cycloconverter are non-conducting.

85. The method of claim 84 including for each cycloconverter sensing the voltages across the naturally commutated switching devices of that cycloconverter and determining that all the naturally commutated switching devices of that cycloconverter are non-conducting when all the voltages across all the naturally commutated switching devices of that cycloconverter are above a predetermined level.

86. The method of claim 83 including for each cycloconverter bandpass filtering the instantaneous output current of that cycloconverter to produce a filtered signal to reduce current ripple and ensure that a 60 Hz fundamental frequency component of the filtered signal does not have any phase-shift relative to the instantaneous output current of that cycloconverter, and comparing the filtered signal to at least one reference level to determine whether the instantaneous output current of that cycloconverter transitioned from positive to negative or from negative to positive.

87. The method of claim 86 wherein the reference level includes first and second reference levels of + 0.1 A and -0.1A.

88. The method of claim 80 wherein the switch is a single pole relay.

89. The method of claim 80 including:

switching the generator system from the first mode to the second mode by first opening the switch, then disabling the naturally commutated switching devices of the first and second cycloconverters so that they are all non-conducting, and after a predetermined delay, reenabling the naturally commutated switching devices of the first and second cycloconverters and operating the first and second cycloconverters so that the voltages produced at the live outputs of the first and second cycloconverters are one-hundred and eighty degrees out of phase with each other, and

switching the generator system from the second mode to the first mode by disabling the naturally commutated switching devices of one of the first and second cycloconverters, reenabling after a predetermined delay the naturally commutated switching devices that were disabled and operating the first and second cycloconverters so that the voltages produced at their live outputs are in-phase, and then closing the switch.

90. A method of controlling a generator system having an AC generator with an output coupled to a cycloconverter, the cycloconverter having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices, the method comprising developing control waves based upon the position of the rotor and using the control waves to control switching of the naturally commutated switching devices.

91. The method of claim 90 wherein the generator system includes a plurality of rotor position sensors that generate signals indicative of the position of the rotor that are displaced one-hundred and twenty degrees from each other, the method including using the rotor position signals to generate the control waves.

92. The method of claim 91 including generating a reference wave, comparing the control waves to the reference wave and generating firing signals for the naturally commutated switching devices based on comparisons of the control waves to the reference wave.

93. The method of claim 92 wherein the generator system includes an engine for driving the AC generator, the method including driving the AC generator as a brushless DC motor to start the engine and using the rotor position signals in doing so.

94. The method of claim 91 including operating the positive and negative banks of the cycloconverter in a non-circulating mode and enabling one of the positive and negative banks and disabling the other of the positive and negative banks based on the instantaneous output current of the cycloconverter produced at an output of the cycloconverter transitioning between positive and negative or between negative and positive wherein the one of the positive and negative banks being enabled is enabled only after a true zero current condition occurs at the output of the cycloconverter.

95. The method of claim 94 including determining that the true current condition occurs when all of the naturally commutated switching devices are non-conducting.

96. The method of claim 95 including sensing the voltages across the naturally commutated switching devices and determining that all the naturally commutated switching devices are non-conducting when the voltages across all of the naturally commutated switching devices are above a predetermined level.

97. The method of claim 96 including bandpass filtering the instantaneous output current of the cycloconverter to produce a filtered signal to reduce current ripple and ensure that a fundamental frequency component of the filtered signal does not have any phase-shift relative to the instantaneous output current, and comparing the filtered signal to at least one reference level to determine whether the instantaneous output current transitioned from positive to negative or from negative to positive.

98. The method of claim 97 wherein the reference level includes first and second reference levels of +0.1A and -0.1A.

99. A method of controlling a generator system having an AC generator with an output coupled to a cycloconverter, the cycloconverter having a positive bank of naturally commutated switching devices and a negative bank of naturally commutated switching devices, the method comprising operating the positive and negative banks of the cycloconverter in a non-circulating mode and enabling one of the positive and negative banks and disabling the other of the positive and negative banks based on the instantaneous output current of the cycloconverter produced at an output of the cycloconverter transitioning between positive and negative or between negative and positive, and bandpass filtering the instantaneous output current of the cycloconverter to produce a filtered signal to reduce current ripple and ensure that a fundamental frequency component of the filtered signal does not have any phase-shift relative to the instantaneous output current, and comparing the filtered signal to at least one reference level to determine whether the instantaneous output current transitioned from positive to negative or from negative to positive.

100. The method of claim 99 including enabling the one of the positive and negative banks being enabled only after the other of the positive and negative banks has been disabled and a true zero current condition occurs at the output of the cycloconverter.

101. The method of claim 100 including determining that the true current condition occurs when all of the naturally commutated switching devices are non-conducting.

102. The method of claim 101 including sensing the voltages across the naturally commutated switching devices and determining that all the naturally commutated switching devices are non-conducting when the voltages across all of the naturally commutated switching devices are above a predetermined level.

103. The method of claim 99 wherein the fundamental frequency is 60 Hz.

104. The method of claim 99 wherein the reference level includes first and second reference levels of +0.1A and -0.1A.

105. The generator system of claim 35 wherein the controller includes a first controller for controlling the first cycloconverter and a second controller for controlling the second cycloconverter.

106. The generator system of claim 55 wherein the controller includes a first controller for controlling the first cycloconverter and a second controller for controlling the second cycloconverter.

107. The generator system of claim 10 wherein the controller simulates back emf voltage waveforms of the generator using the rotor position signal and develops control waves from the back emf voltage waveforms which it uses to control the cycloconverters.

108. The generator system of claim 12 wherein the controller simulates back emf voltage waveforms of the generator using the rotor position signals and develops control waves from the back emf voltage waveforms which it uses to control the cycloconverters.

109. The generator system of claim 35 wherein the controller simulates back emf voltage waveforms of the generator using the rotor position signal and develops the control waves from the back emf voltage waveforms.

110. The generator system of claim 36 wherein the controller simulates back emf voltage waveforms of the generator using the rotor position signals and develops the control waves from the back emf voltage waveforms.

111. The generator system of claim 55 wherein the controller simulates back emf voltage waveforms of the generator using the rotor position signals and develops the cosine control waves from the back emf voltage waveforms.

112. The method of claim 67 including simulating back emf voltage waveforms of the generator using the rotor position signals and developing the control waves from the back emf waveforms.

113. The method of claim 80 including simulating back emf voltage waveforms of the generator using the rotor position signals and developing the cosine control waves from the back emf waveforms.

114. The method of claim 90 including simulating back emf voltage waveforms of the generator based upon the position of the rotor and developing the control waves based on the back emf voltage waveforms.

115. The generator system of claim 19 and further including a portable universal battery pack coupled to the brushless DC motor drive circuit that provides DC power to the brushless DC motor drive circuit.

116. The generator system of claim 20 and further including a portable universal battery pack coupled to the brushless DC motor drive circuit that provides DC power to the brushless DC motor drive circuit.

117. The generator system of claim 39 and further including a portable universal battery pack coupled to the brushless DC motor drive circuit that provides DC power to the brushless DC motor drive circuit.

118. The generator system of claim 56 and further including a portable universal battery pack coupled to the brushless DC motor drive circuit that provides DC power to the brushless DC motor drive circuit.

119. The method of claim 69 further including using a portable universal battery pack coupled to the brushless DC motor drive circuit to supply DC power to the brushless DC motor drive circuit.

120. The method of claim 81 and further including using DC power of a portable universal battery of the generator system in starting the engine.

121. The method of claim 93 and further including using DC power of a portable universal battery of the generator system in starting the engine.